

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listing of claims in the application.

Listing of Claims

1. (Currently Amended) A storage allocation method for allocating a vacant storage region to a virtual volume from storage regions of at least one of storage devices when storage regions maintained by the storage devices are provided as virtualized volumes to a host computer, said method comprising:

a first step of allocating a storage region for a required size to be allocated from said vacant storage region so that a ~~until an unallocated~~ remaining unallocated part size in of the required size to be allocated becomes smaller than a specified maximum region size of the vacant storage region; and

a second step of, when said remaining unallocated part of said required size to be allocated becomes smaller than said maximum region size of the vacant storage region, acquiring a storage region, ~~whose~~ having a size that is a ~~the~~ smallest increment of the power of two that is not smaller than said remaining unallocated part of the required size, from said vacant storage region for allocation.

2. (Original) A storage allocation method according to claim 1, further comprising a third step of, if said vacant storage region includes a plurality of continuous vacant regions, selecting the largest continuous vacant region for allocation.

3. (Original) A storage allocation method according to claim 1, further comprising a third step of, if said vacant storage region adjoins an allocated storage region on each side thereof, acquiring for allocation a storage region adjoining the allocated storage region which is less likely to be released.

4. (Currently Amended) A storage allocation method according to claim 1, further comprising a third step of, if sorting the vacant storage regions ~~are sorted~~ into a plurality of groups ~~allowing load dispersion among the groups and it is requested to divide and dividing~~ the virtual volume into a plurality of divisions allowing for load dispersion among the divisions, dividing the required size to be allocated according to the specified number of divisions and assigning the divided required sizes to be allocated respectively to the plurality of groups for allocation.

5. (Currently Amended) A storage allocation method according to claim 4 wherein in said third step, if the number of said groups is greater ~~larger~~ than said number of divisions, ~~selects as many groups as the divisions in the decreasing order of the total vacant capacity, divides the required size and assigns the divided required sizes to be allocated are~~ respectively assigned to the selected groups in decreasing order of the total vacant capacity for allocation.

6. (Currently Amended) A storage allocation method according to claim 1 wherein the first step allocates ~~the a~~ largest region, whose size is an integer times said maximum region size not exceeding said required size to be allocated, from said vacant storage region.

7. (Currently Amended) A storage allocation method according to claim 1 wherein the first step allocates ~~the a~~ largest region, whose size is a power of two not exceeding said required size to be allocated, from said vacant storage region.

8. (Currently Amended) A virtualization device which provides storage regions maintained by at least one storage device to a host computer as virtualized volumes, said virtualization device comprising:

access translation table means for storing information on associativity between an address of each storage region on a virtual volume and the addresses of a corresponding logical unit in the storage device and a corresponding storage region in said logical unit;

means for translating an input/output request for said virtual volume into an input/output request for the storage region of said storage device with reference to said access translation table means;

means for accepting a request to allocate a vacant storage region to said virtual volume from storage regions of said storage device;

means for allocating a storage region for a required size to be allocated from said vacant storage region so that until an unallocated remaining unallocated part of the size in the required size to be allocated becomes smaller than a specified maximum region size of the vacant storage region;

means for acquiring a storage region, ~~whose size is the smallest~~ having a size that is a smallest increment of the power of two that is not smaller than said remaining unallocated part of the required size to be allocated, from said vacant storage region for allocation when said remaining unallocated part of the size becomes smaller than said maximum region size of the vacant storage region; and

means for, after storage allocation is complete for the allocation request, updating a content of said access translation table means based on the allocation result.

9. (Original) A virtualization device according to claim 8, further comprising means for, if said vacant storage region includes a plurality of continuous vacant regions, selecting the largest continuous vacant region for allocation.

10. (Original) A virtualization device according to claim 8, further comprising means for, if said vacant storage region adjoins an allocated storage region on each side thereof, acquiring for allocation a storage region adjoining the allocated storage region which is less likely to be released.

11. (Currently Amended) A virtualization device according to claim 8, further comprising means for sorting the vacant storage regions into a plurality of groups and dividing the virtual volume into a plurality of divisions for load dispersion among the divisions, dividing the required size to be allocated according to the specified number of divisions and assigning the divided required sizes to be allocated respectively to the groups for allocation ~~if the vacant storage regions are sorted into a plurality of groups allowing load dispersion among the groups and it is requested to divide the virtual volume into a plurality of divisions allowing load dispersion among the divisions.~~

12. (Currently Amended) A virtualization device according to claim 11, further comprising means for, if the number of said groups is greater ~~larger~~ than said number of divisions, ~~selecting as many groups as the divisions in the decreasing order of the total vacant capacity, dividing the required size and assigning the divided~~ required sizes to be allocated are respectively assigned to the selected groups in decreasing order of the total vacant capacity for allocation.

13. (Original) A storage device incorporating the virtualization device according to claim 8.

14. (Currently Amended) A program stored on a computer readable storage medium executing a method on a computer ~~for allowing a computer to~~ implement a capability of providing storage regions maintained by storage devices as virtualized volumes to the computer and a capability of allocating a vacant storage region to a virtual volume from storage regions of at least one storage device, said capability of allocating vacant storage comprising ~~the functions~~ steps of:

allocating a storage region for a required size to be allocated from said vacant storage region ~~so that until an unallocated~~ remaining unallocated part size in the of the required size to be allocated becomes smaller than a specified maximum region size of the vacant storage region; and

when said remaining unallocated part of the required size to be allocated becomes smaller than said maximum region size of the vacant storage region, acquiring a storage region; ~~whose size is the~~ having a size that is a smallest increment of the power of two that is not smaller than said remaining unallocated part of the required size to be allocated, from said vacant storage region for allocation.

15. (Original) A program according to claim 14, further allowing the computer to, if said vacant storage region includes a plurality of continuous vacant regions, select the largest continuous vacant region for allocation.

16. (Original) A program according to claim 14, further allowing the computer to, if said vacant storage region adjoins an allocated storage region on each side thereof, acquire for allocation a storage region adjoining the allocated storage region which is less likely to be released.

17. (Currently Amended) A program according to claim 14, further allowing the computer to, ~~if~~ sort the vacant storage regions ~~are sorted~~ into a plurality of groups ~~allowing load dispersion among the groups and it is requested to divide and divide~~ the virtual volume into a plurality of divisions ~~allowing for~~ load dispersion among the divisions, ~~divide~~ dividing the required size to be allocated according to the specified number of divisions and assign ~~assigning~~ the divided required sizes to be allocated respectively to the plurality of groups for allocation.

18. (Currently Amended) A program according to claim 17, allowing the computer to, if the number of said groups is larger than said number of divisions, ~~select as many groups as the divisions in the decreasing order of the total vacant capacity, divide the required size and~~ assign the divided required sizes to be allocated respectively to the selected groups in decreasing order of the total vacant capacity for allocation.

19. (Currently Amended) A system comprising:

- at least one storage device maintaining a real storage region;
- at least one host processor which initiates data read and write from and to said real storage region of said storage device;
- a virtualization device which interferes between said host processor and said storage device and provides virtual volumes to said host processor; and
- a management console which issues a request said virtualization device to allocate a storage region for a virtual volume;

wherein said virtualization device comprises:

- access translation table means for storing information on associativity between an address of each storage region on the virtual volume and the addresses of a corresponding logical unit in the storage device and a corresponding storage region in said logical unit;
- means for translating an input/output request for said virtual volume into an input/output request for the storage region of said storage device with reference to said access translation table means;
- means for accepting from said management console a request to allocate a vacant storage region to said virtual volume from storage regions of said storage device;
- means for allocating a storage region for a required size to be allocated from said vacant storage region so that until an unallocated remaining unallocated part of the size in the required size to be allocated becomes smaller than a specified maximum region size of the vacant storage region;
- means for acquiring a storage region, ~~whose size is the smallest~~ having a size that is a smallest increment of the power of two that is not smaller than said remaining unallocated part of the required size to be allocated, from said vacant storage region for allocation when said remaining unallocated part of the size becomes smaller than said maximum region size of the vacant storage region; and
- means for updating a content of said access translation table means based on the allocation result after storage allocation is complete for the allocation request.